THE HOUSING AND FOOD SERVICE WAREHOUSE AND BAKERY EXPANSION

PENNSTATE

Penn State AE Senior Capstone Project

Joseph Rutt

Construction Option

Advisor: anumba

April 13th, 2016

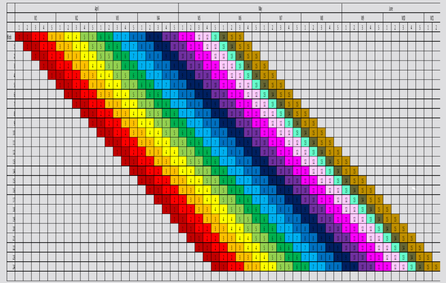
INTRODUCTION

PRESENTATION OUTLINE:

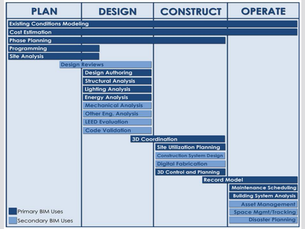
PROJECT OVERVIEW

Googlemaps.com

ANALYSIS 1 | SIPS ANALYSIS

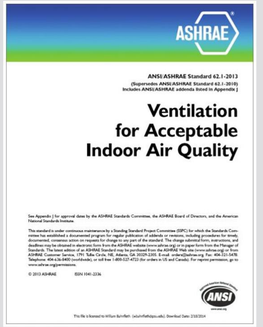


ANALYSIS 2 | BIM UTILIZATION



The Pennsylvania State University BIM Execution Planning Guide

ANALYSIS 3 | INDOOR AIR QUALITY



ASHRAE

ANALYSIS 4 | LEED CERTIFICATION

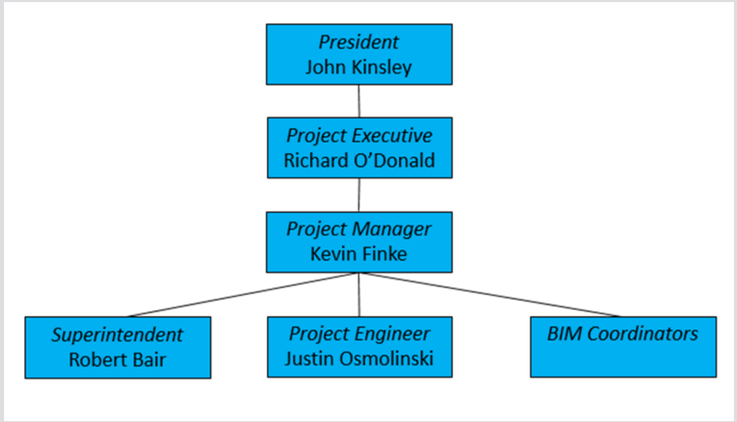
LEED USGBC

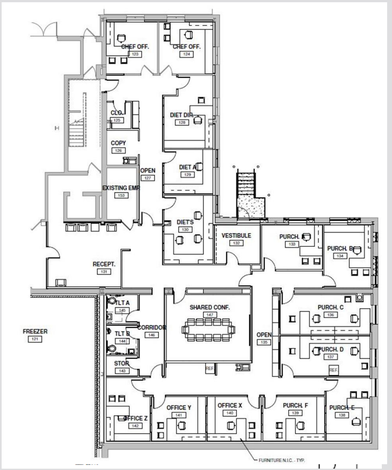
PROJECT BACKGROUND

Building Information:

- Original Size 94,000SF
- 44,500SF renovation of existing building
- 25,000SF Warehouse addition
- Approximately $13 Million Project
- March 2015 – March 2016
- Design Build

Kinsley Construction





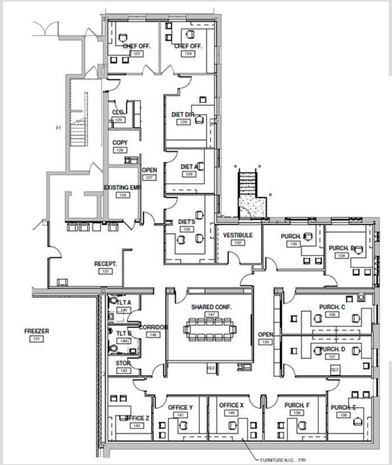
Analysis #1

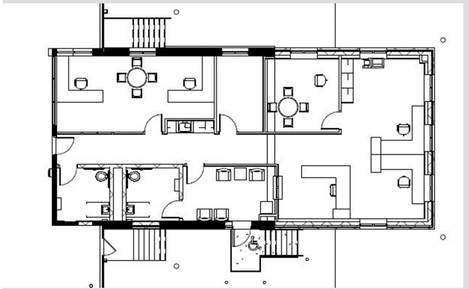
SIPS Analysis

SIPS SCHEDULE

Problem Identification:

- Cannot occupy office space during renovations
- Renovations during two different phases





Proposed Solution:

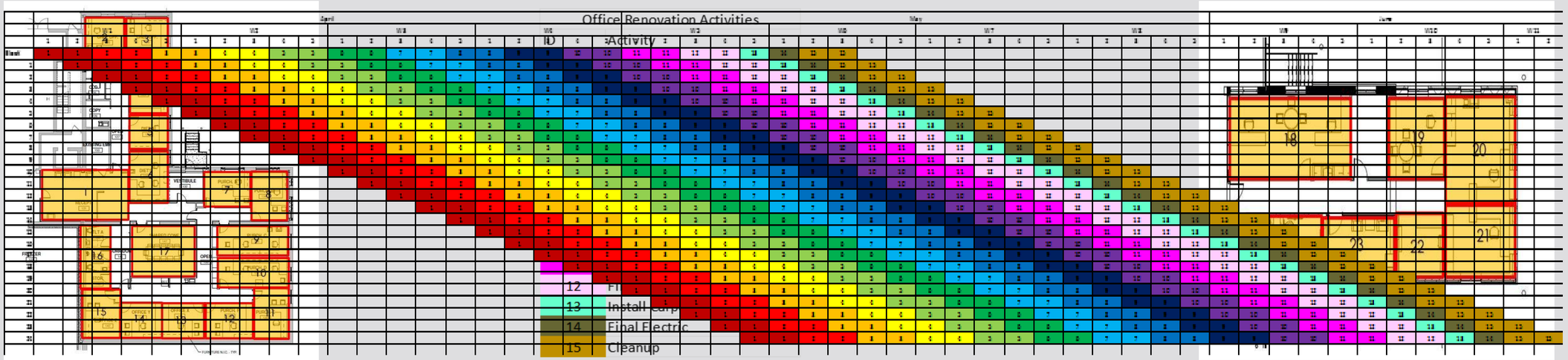
- SIPS Analysis of office renovation

Research Goal:

- Decrease time to renovate offices
- Schedule Matrix

SCHEDULE MATRIX

PRESENTATION OUTLINE:



FEASIBILITY ANALYSIS

Schedule:

- About 5 weeks to completely finish one room
- Total of 10 weeks and 2 days to complete
- Finished 5 weeks ahead of the 16 week schedule
- Renovation of both office space during Phase 3

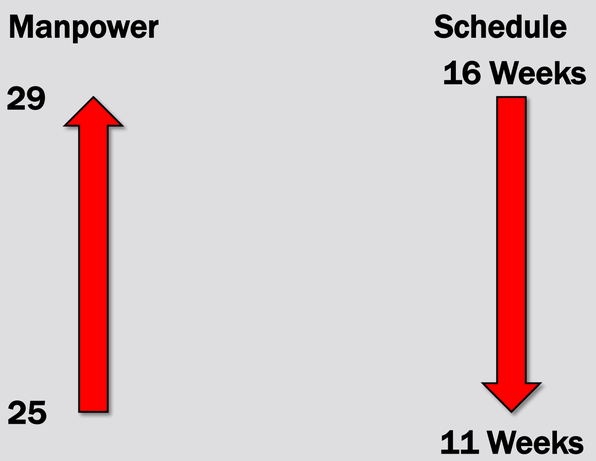
Provided by Kinsley Construction

Provided by Kinsley Construction

RECOMMENDATIONS

Schedule Impact:

- Decreased schedule by 37 Days



Recommendation:

- Implement the SIPS Analysis for office renovations

Potential Value Added:

- Occupant Satisfaction
- Organized trades
- Decreased schedule

PRESENTATION OUTLINE:

Analysis #2

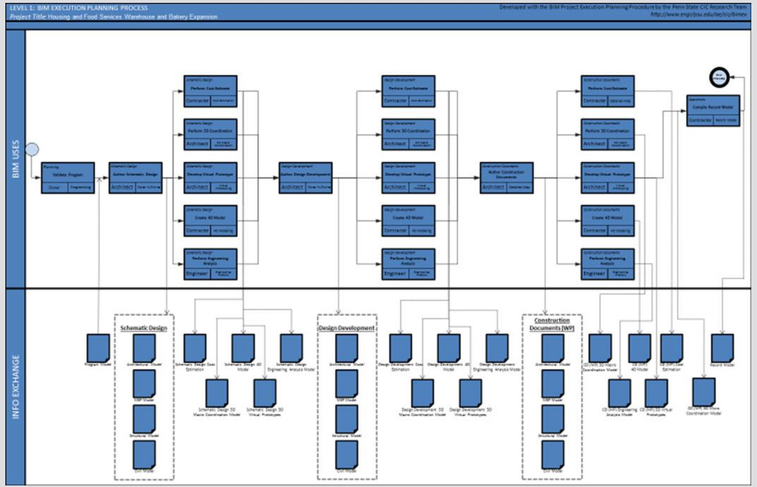
BIM Utilization

BIM UTILIZATION

PRESENTATION OUTLINE:

Problem Identification:

- BIM was not used on this project
- Many RFI's and ASI's
- Large contingency held



Proposed Solution:

- 3D and 4D coordination

Potential Outcomes:

- Cost of creating 3D and 4D model is too high
  - outweighs the costs saved from the use of BIM.
- Amount of time saved by limiting RFI's is substantial and therefore BIM should be utilized.
- Amount of time added by the creation of the 3D and 4D model is more than the time saved.

FEASIBILITY ANALYSIS

Tasks:

- Create a 3D model of existing building
- Utilize clash detection
- 4D model of warehouse bay and storage

X	Plan	X	Design	X	Construct	X	Operate
	Programming		Design Authorizing	X	Site Utilization Plan	X	Building Maintenance
X	Site Analysis	X	Design Reviews	X	Construction System		System Analysis
			3D Coordination		3D Coordination		Asset Management
			Structural Analysis		Digital Fabrication		Space Tracking
			Lighting Analysis		3D Planning		Disaster Planning
			Energy Analysis		Record Modeling		Record Modeling
			Mechanical Analysis				
			Other Analysis				
		X	Sustainability				
			Code Validation				
X	4D Modeling		4D Modeling	X	4D Modeling		4D Modeling
X	Cost Estimation	X	Cost Estimation	X	Cost Estimation	X	Cost Estimation
	Existing Conditions	X	Existing Conditions	X	Existing Conditions	X	Existing Conditions

Predicted Outcome

- 3D model relieves issues with as-built drawings
- Eliminate RFI's and ASI's
- 4D model sequence phases and create maps for construction site

RECOMMENDATION

PRESENTATION OUTLINE:

Recommendation:

- BIM is recommended for this project
- Reduces problems with as-built model
- Reduces RFI's and ASI's

BIM USE Selection

BIM Uses per Phase	Responsible Parties: Desire to Implement (Y/N/Maybe)	Lead Team Member	Addt'l Team Members	Experience Level (1-5) 5=High	Process Map Available?	Comments
Operations Phase						
Record Model	Y	Contractor		2	N	
			MEP Subs	1	N	Responsible for As-Built Model / Info
			A/E	2	N	Provide input on information required
Building System Analysis	Maybe	Contractor		3	N	
Building Maintenance Scheduling	Y	Owner		4		
Construction Phase						
Site Utilization Planning	Maybe	Contractor		3	N	Staging, Temp Utilities, Crane Info
			MEP Subs	2	N	Underground Modeling / Information
3D Control and Planning	N					
3D Design / MEP Coordination	Maybe	Contractor	MEP Subs	4	Y	See Project Map

Design Phase						
Design Authoring	Y	Arch		4	N	Level of Detail Needs Defined
Engineering Analysis	Maybe	Contractor		2		
Planning Phase						
Programming	Maybe	Arch		2	N	Software Requirement
			Owner			Initial Input Required
Site Analysis	Y	Arch	Owner	3		Schedule and Software - see Map
Multi-Phase						
Phase Planning (4D Modeling)	N					
Cost Estimation	Y	Contractor		3	N	Scope Needs Defined
			Arch	3	N	Level of Detail Needs Defined
Existing Conditions Modeling	N					

PRESENTATION OUTLINE:

Analysis #3

Indoor Air Quality

INDOOR AIR QUALITY

Problem Identification:

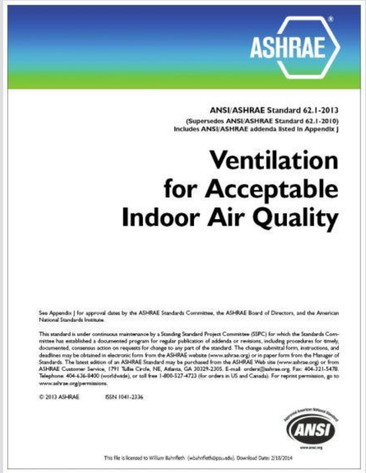
- Poor air quality can effect occupant's health

Proposed Solution:

- Increase the quality of air for the occupants

Research Goal:

- Find breathing zone outdoor airflow
- Air distribution effectiveness
- Zone outdoor airflow


ASHRAE

ANSI/ASHRAE Standard 62.1-2013
(Supersedes ANSI/ASHRAE Standard 62.1-2010)
Includes ANSI/ASHRAE addenda listed in Appendix J

Ventilation for Acceptable Indoor Air Quality

See Appendix J for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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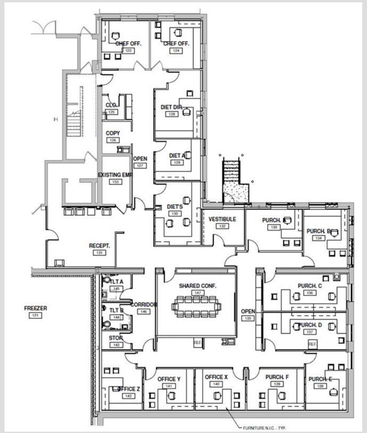
ASHRAE Standard 62.1 - 2013



Unit H – Office Space

INDOOR AIR QUALITY

Breathing Zone Outdoor Airflow Vbz (cfm)
0
16
58
17
54
62
15
11
0
28
17
17

Indoor Air Quality Analysis - Unit H

Zone name	Zone Area Az (ft^2)	Zone Population Pz (people)	Breathing Zone Outdoor Airflow Vbz (cfm)	Zone Air Distribution Effectiveness Ez	Zone Outdoor Airflow Voz (cfm)
Restroom	214	2.00	0	1.00	0
Reception	144	1.44	16	1.00	16
Chef Office	215	4.30	58	1.00	58
Copy Room	152	1.52	17	1.00	17
Shared Confrence Room	488	4.88	54	1.00	54
Break Room	206	10.00	62	1.00	62
Storage	115	0.23	15	1.00	15
Supply Closet	62	0.62	11	1.00	11
Corridor	226	0.00	0	1.00	0
Office A	256	2.56	28	1.00	28
Office B	156	1.56	17	1.00	10
Office C	155	1.55	17	1.00	10
System Area (sq ft)	3,015				
System Population (people)	30.66				
Uncorrected Outdoor Air Intake (cfm)	295				
Outdoor Air Intake Flow (+30%) (cfm)	383				

Calculating Breathing Zone Outdoor Air Flow (V_{bz}):

$$V_{bz} = R_p \times P_z + R_a \times A_z$$

Where

A_z = Zone floor area, the net occupiable floor area of the ventilation zone, ft²

P_z = Zone population, the number of people in the ventilation zone during typical usage

R_p = Outdoor airflow rate required per person as determined from Table 6.2.2.1

R_a = Outdoor airflow rate required per unit area as determined from Table 6.2.2.

INDOOR AIR QUALITY

Zone Air Distribution Effectiveness Ez
1.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00

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Determine Zone Air Distribution Effectiveness (E_z):

E_z is determined using Table 6.2.2.2 in Standard 62.1

INDOOR AIR QUALITY

Zone Outdoor Airflow Voz (cfm)
0
16
58
17
54
62
15
11
0
28
10
10

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Calculating Zone Outdoor Airflow (V_{oz}):

$$V_{oz} = \frac{V_{bz}}{E_z}$$

RECOMMENDATION

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Indoor Air Quality Analysis - Unit H

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System Area (sq ft)	3,015
System Population (people)	30.66
Uncorrected Outdoor Air Intake (cfm)	295
Outdoor Air Intake Flow (+30%) (cfm)	383

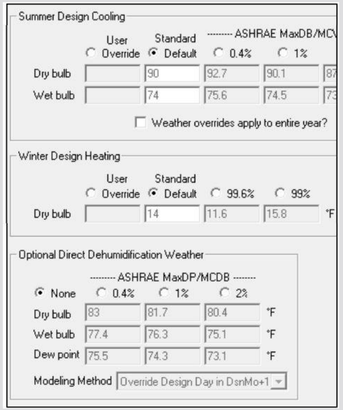
Conclusion:

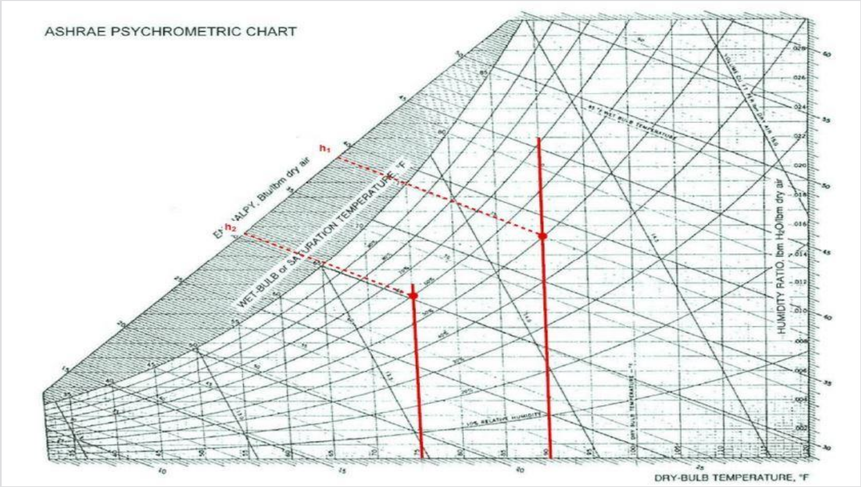
Uncorrected Outdoor Air Intake: 295 CFM

Outdoor Air Intake Flow (+30%): 383 CFM

The mechanical system requires an additional 383 CFM of outdoor air to reach the requirement for the LEED Credit.

MECHANICAL BREADTH





Determining the cooling load for Unit H:

The cooling load the design parameters for Summer Design Cooling are:

- 90.1 Dry bulb
- 74.5 Wet bulb
- Relative humidity of 60%
- Indoor temperature of 75° F.

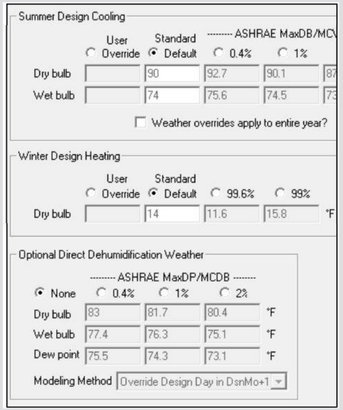
$\dot{q}(btu) = 4.5\ CFM\ \Delta h$

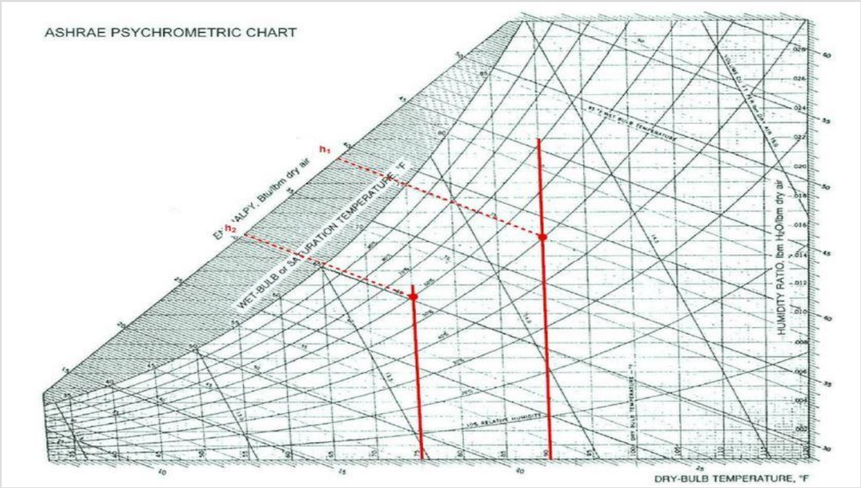
$\dot{q}(btu) = 4.5\ (383)\ (38.8 - 30.4)$

$\dot{q}(btu) = 14{,}477.4\ btuh = \mathbf{14.5\ mbh}$

MECHANICAL BREADTH

PRESENTATION OUTLINE:





Determine the heating load for Unit H:

From the Psychrometric Chart:
h1 = 38.8 btu/lbm
h2 = 30.4 btu/lbm

$\dot{q}\ sens$ = 1.08 $CFM\ \Delta T$

$\dot{q}\ sens$ = 1.08 (383) (75 – 15.8)

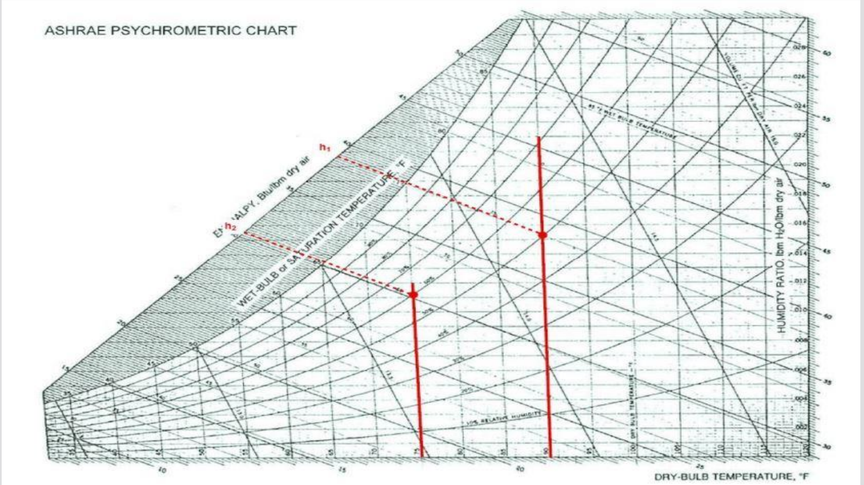
$\dot{q}\ sens$ = 24,487.5 $btuh$ = $\mathbf{24.5\ mbh}$

The heating load above is added to the current load of 100 mbh for a total of 124.5 mbh load for Unit H

MECHANICAL BREADTH

Recommendation:

- 100% outdoor air system
- Cost of change is low and may be negligible
- Provides occupants with a higher quality work environment



$q(btu)$ = **14,477.4** $btuh$ = **14. 5 *mbh***

q_{sens} = **24,487.5** $btuh$ = **24. 5 *mbh***

Total of 124.5 mbh load for Unit H

PRESENTATION OUTLINE:

Analysis #4

LEED Certification

LEED CERTIFICATION

Problem Identification:

- No considerations to pursue LEED Certification
- Project is capable of achieving at least 40 points

Proposed Solution:

- Acquire at minimum 40 points to become a LEED Certified building

Research Goal:

- Benefits lifespan of project
- Lower operating costs
- Reduced project waste
- Energy conservation
- Reduced greenhouse gas emissions
- Tax rebates

LEED CERTIFICATION

PRESENTATION OUTLINE:

LEED v4 for BD+C: Warehouses and Distribution Centers
Project Checklist

Y	?	N			
1			Credit	Integrative Process	1

10	1	5	**Location and Transportation**		16
			Credit	LEED for Neighborhood Development Location	16
1			Credit	Sensitive Land Protection	1
1	1		Credit	High Priority Site	2
2		3	Credit	Surrounding Density and Diverse Uses	5
5			Credit	Access to Quality Transit	5
1			Credit	Bicycle Facilities	1
		1	Credit	Reduced Parking Footprint	1
		1	Credit	Green Vehicles	1

3	2	5	**Sustainable Sites**		10
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
		2	Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
1	2		Credit	Rainwater Management	3
		2	Credit	Heat Island Reduction	2
		1	Credit	Light Pollution Reduction	1

5	2	4	**Water Efficiency**		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
		2	Credit	Outdoor Water Use Reduction	2
4		2	Credit	Indoor Water Use Reduction	6
	2		Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1

9	12	#	**Energy and Atmosphere**		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
	6		Credit	Enhanced Commissioning	6
8		10	Credit	Optimize Energy Performance	18
	1		Credit	Advanced Energy Metering	1
		2	Credit	Demand Response	2
	3		Credit	Renewable Energy Production	3
1			Credit	Enhanced Refrigerant Management	1
	2		Credit	Green Power and Carbon Offsets	2

2	2	6	**Materials and Resources**		13
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
	2		Credit	Building Life-Cycle Impact Reduction	5
		2	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
		2	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
		2	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2

9	1	6	**Indoor Environmental Quality**		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
3			Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
2			Credit	Indoor Air Quality Assessment	2
		1	Credit	Thermal Comfort	1
1	1		Credit	Interior Lighting	2
		3	Credit	Daylight	3
		1	Credit	Quality Views	1
		1	Credit	Acoustic Performance	1

1	2	3	**Innovation**		6
	2	3	Credit	Innovation	5
1			Credit	LEED Accredited Professional	1

2	0	2	**Regional Priority**		4
1			Credit	Regional Priority: Specific Credit	1
1			Credit	Regional Priority: Specific Credit	1
		1	Credit	Regional Priority: Specific Credit	1
		1	Credit	Regional Priority: Specific Credit	1

42	22	43	**TOTALS**	Possible Points: 110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

RECOMMENDATION

Recommendation:

- Pursue the lowest LEED Certification with a minimum of 40 points

Components:

- Integrative Process – 1 point
- Location & Transportation – 10 points
- Sustainable Site – 3 points
- Water Efficiency – 5 points
- Energy & Atmosphere – 9 points
- Material & Resources – 2 points
- Indoor Environmental Quality – 9 points
- Innovation – 1 point
- Regional Priority – 2 points

Total points: 42

LEED Certified

CONCLUSION

Provided by Kinsley Construction

ANALYSIS 1 | SIPS ANALYSIS

- Implement the SIPS Analysis for office renovations
  - Occupant Satisfaction
  - Organized trades
  - Decreased schedule

ANALYSIS 2 | BIM UTILIZATION

- BIM is recommended for this project
  - Reduces problems with as-built model
  - Reduces RFI's and ASI's

ANALYSIS 3 | INDOOR AIR QUALITY

- Implementation of the mechanical system is recommended to achieve the LEED credit

ANALYSIS 4 | LEED CERTIFICATION

- There are at least 42 possible points for this building, strongly recommend pursuit of LEED Certified Building

ACKNOWLEDGEMENTS

Architectural Engineering Faculty:

Dr. Chimay Anumba (Advisor)

PENNSTATE

PENNSTATE
Department of
Architectural Engineering

Special Thanks to:

My Family & Friends
Kevin Finke – Kinsley Construction
Justin Osmolinski – Kinsley Construction
PACE Industry Members

Industry Acknowledgements:

KINSLEY CONSTRUCTION

BARTON ASSOCIATES

LSCdesign

CEG
CARNEY ENGINEERING GROUP

Sweetland Engineering
& ASSOCIATES, INC.

THANK YOU

Questions & Comments

Provided by Kinsley Construction